A3525
10.156

United States Department of Agriculture

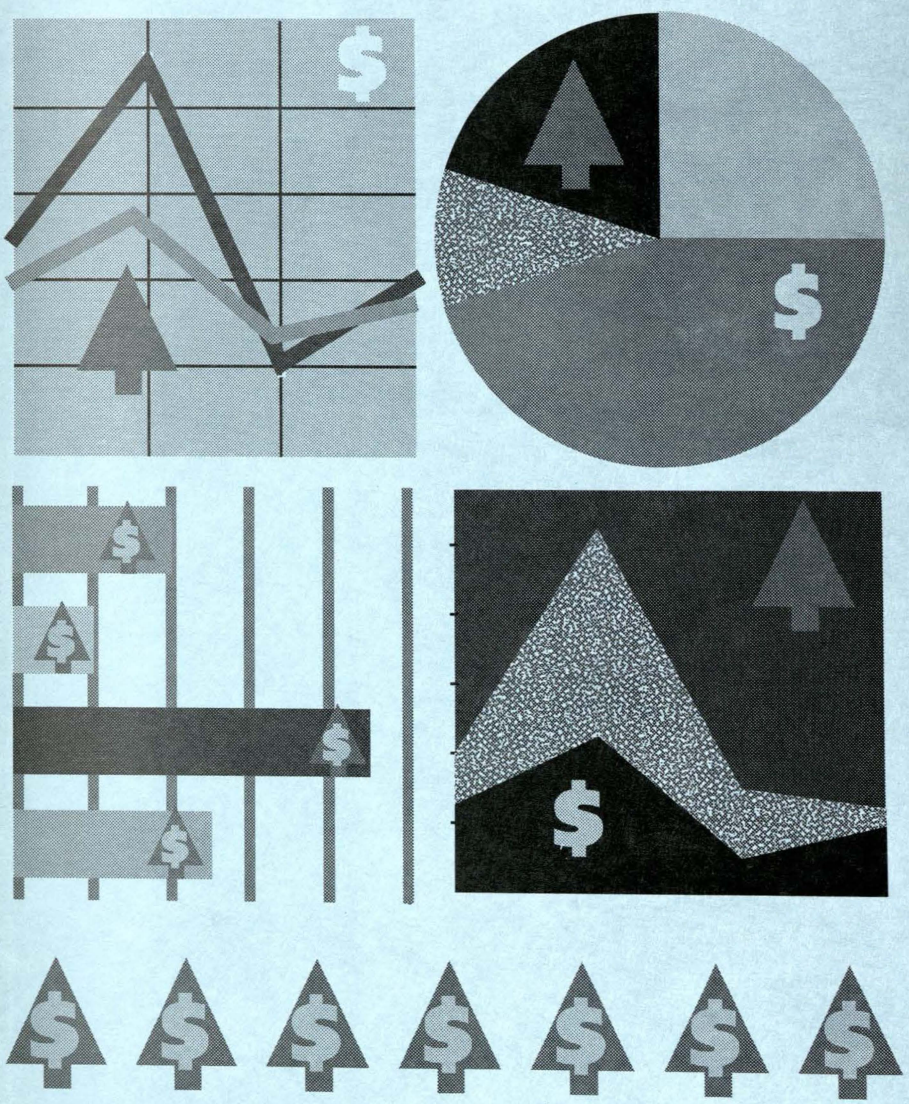
Forest Service

North Central Forest Experiment Station

General Technical Report **NC-156**

User's Guide: RPGrow$: A Red Pine Growth And Analysis Spreadsheet For The Lake States

Carol A. Hyldahl and Gerald H. Grossman



The policy of the United States Department of Agriculture Forest Service prohibits discrimination on the basis of race, color, national origin, age, religion, sex, or disability. Persons believing they have been discriminated against in any Forest Service related activity should write to: Chief, Forest Service, USDA, Washington, DC 20250.

North Central Forest Experiment Station
Forest Service—U.S. Department of Agriculture
1992 Folwell Avenue
St. Paul, Minnesota 55108
Manuscript approved for publication July 20, 1993
1993

Software Disclaimer - RPGrow$

This software (including instructions for its use) is provided "as is" without warranty of any kind. Further, the USDA Forest Service and the authors do not warrant, guarantee, or make any representations regarding the use, or the results of the use, of the software or written materials concerning the software in terms of correctness, accuracy, reliability, currentness, or otherwise. The entire risk as to the results and performance of the software is assumed by you. If the software or written materials are defective, **you**, and not the authors, USDA Forest Service, or its dealers, distributors, agents, or employees, assume the cost of servicing, repair, or correction.

In no event will the authors, the USDA Forest Service, or anyone else involved in the creation, production, or delivery of this software be liable to you for any damages (including any lost profits, lost savings, or other incidental or consequential damages arising out of the use of or the inability to use RPGrow$) or for any claim by any other party.

ACKNOWLEDGMENTS

RPGrow$ was developed by the authors with partial support from the Mead Corporation (Escanaba, Michigan), McIntire Stennis project MICL00978, and the Agricultural Experiment Station of Michigan State University.

The authors would like to acknowledge the helpful assistance and comments provided by the following people:

Douglas DeKoster, Mead Corporation, Escanaba, Michigan
Brad Franchi, Mead Corporation, Columbus, Georgia
Russell Kidd, Michigan State University, Roscommon, Michigan
Kerry Livengood, Forest Resources Systems Institute, Florence, Alabama
Karen Potter-Witter, Michigan State University, East Lansing, Michigan
Carl W. Ramm, Michigan State University, East Lansing, Michigan
Eric Schatz, Mead Corporation, Escanaba, Michigan
J. Michael Vasievich, USDA Forest Service, East Lansing, Michigan

The authors would especially like to acknowledge Noel Bennett and Bobbe McDaniel, USDA Forest Service, East Lansing, Michigan, for typing this documentation.

CONTENTS

Page

Introduction 1
System Requirements 1
Spreadsheet Design 2
Getting Started 3
User Input Screens 4
  Screen 1: Growth and Yield Assumptions and Thinning Strategy 4
  Screen 2: Alternative Assumptions 6
  Screen 3: Financial and Annual Incremental Costs 8
  Screen 4: One-Time Incremental Cost Assumptions 10
  Screen 5: One-Time Incremental Cost Assumptions (cont.) 12
Other Screens 13
  Growth and Yield Summary 13
  Red Pine Revenue 15
  Timber Account 16
Result Screens 17
  Yearly Growth Summary 17
  Financial Summary 18
Printing and Saving Spreadsheets 20
  Printing 20
  Saving Spreadsheet 20
Error Messages and Warnings 21
Models 22
  Volume Models 22
  Growth Models 23
  Economic Models 23
Literature Cited 23
Appendix 24
  Adjusting Number of Years Between Thinnings 25
  Changing Volume Equation 25
  Changing Log Scale 26
  How To Obtain a Disk Copy 29

User's Guide: RPGrow$: A Red Pine Growth And Analysis Spreadsheet For The Lake States

Carol A. Hyldahl and Gerald H. Grossman

RPGrow$ is based on RPAL (Red Pine Al Lundgren) and expanded to include financial analysis. RPAL (Ramm 1989, 1990), a stand-level interactive program for growth and yield of red pine plantation, is based on basal area growth models from Wambach (1967), Buckman (1962), and Lundgren (1981). Ramm wrote and compiled RPAL in QuickBasic for IBM-compatible computers. The initial idea for RPAL came from Marty (1981), who developed a TI-59 program to project red pine plantation yields.

INTRODUCTION

RPGrow$ is a spreadsheet that interactively calculates stand-level growth and yield predictions with financial analysis for red pine plantations in the Lake States. The spreadsheet is based on basal area growth models from Wambach (1967), Buckman (1962), and Lundgren and Belcher (1982). The financial analysis is based on discounted cash flow. The user inputs site index, stand age, basal area, trees/acre, thinning regime, incremental cost data, and price data. The growth model will automatically project stands for 70 years (see Appendix for additional information).

Three types of commonly found conditions related to red pine management in the Lake States can be analyzed. An entire rotation can be analyzed from initial plantings to final harvest. An existing stand can be analyzed from any point in time until final harvest. A marginal analysis can be done for converting an existing stand to red pine.

Two product choices are available: pulpwood, or pulpwood *and* sawtimber. If the value of sawtimber is set to $0.00, the spreadsheet will automatically consider pulpwood only.

SYSTEM REQUIREMENTS

RPGrow$ is written in Lotus 1-2-3 Version 2.01. Users will need a minimum of 640K RAM to run the spreadsheet (approximately 335K available RAM after the Lotus software is loaded).

This spreadsheet can be readily imported into Microsoft Excel Version 3.0 and 4.0[1] and Borland's Quattro Pro Version 3.0. Approximately 435K and 445K free RAM are needed for the Microsoft Excel Versions 3.0 and 4.0, respectively. Approximately 338K free RAM is needed for Borland's Quattro Pro Version 3.0. RPGrow$ has also been successfully imported into Microsoft Excel for the Apple McIntosh.

This documentation assumes RPGrow$ is written in Lotus 1-2-3 and uses the commands for this software spreadsheet.

Carol Hyldahl is a Research Forester with the North Central Forest Experiment Station in East Lansing, Michigan and **Gerald Grossman** is a Consulting Forester with the Grossman Forestry Company in Newberry, Michigan.

[1] *Mention of trade names does not constitute endorsement of the product by the U.S. Department of Agriculture.*

SPREADSHEET DESIGN

RPGrow$'s layout is replicated in figure 1. The boxes with the doubled-lined borders represent user input screens. The remaining sections of the spreadsheet are calculated after values have been entered into the user input screens. Cell addresses, indicating the beginning of new sections in RPGrow$, appear at the top of the boxes. Use the "Goto" key [F5] to view a section. For example, if you want to see the timber account, enter F5 and then the cell address I101.

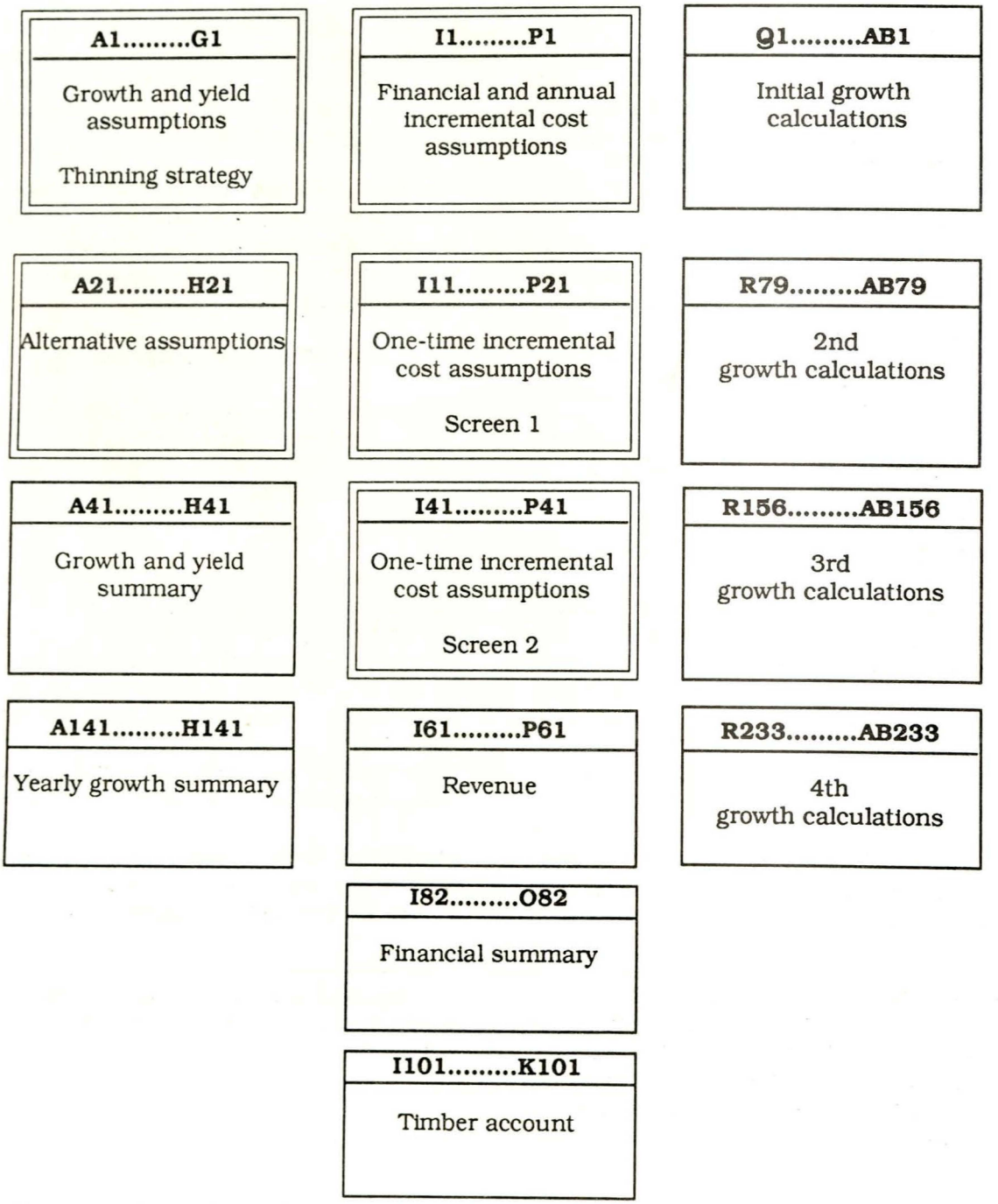


Figure 1.—*Spreadsheet layout (not to scale).*

GETTING STARTED

RPGrow$ can be run off a floppy disk, but, it is rather large and therefore slow. We suggest you make a hard disk directory under Lotus 1-2-3, and then copy the file, RPGrow$.WK1, to that directory (for example, C:\123\RPINE\RPGrow$.WK1). Once Lotus 1-2-3 is loaded, use the **F**ile **R**etrieve commands to bring up the spreadsheet, RPGrow$.WK1.

Beginning with the opening screen, supply values for each unprotected variable. These variables are easily recognized because they are "**bolded**" in both the spreadsheet and documentation. The protected cells or variables are not in bold type. They are calculated within the spreadsheet based on values you supply. Leave these cells protected.

Once you've entered values for all the unprotected variables on the opening screen, follow the "Goto" message on the bottom of each screen to move through the spreadsheet. Remember to use the F5 key (the Goto command key), which moves the cell pointer to the cell specified. For example, the message on the opening screen (fig. 2) says, "Goto Cell A21." You would press F5, type A21, and then press the Enter key. The spreadsheet would be repositioned and ready for more user input.

Automatic recalculation is turned off for RPGrow$. After you change values in the spreadsheet, Lotus 1-2-3 displays the [CALC] prompt. Use the F9 key to recalculate.

RPGrow$ should be used as a template. After entering data, save the file under another name. For example, use the **F**ile **S**ave command and rename the file - Plot3.WK1.

WARNING—Make sure there are no undesirable values from previously saved spreadsheets.

USER INPUT SCREENS

RPGrow$ contains five user input screens. After entering all values, use the F9 key to recalculate the spreadsheet before results are interpreted.

The format of the documentation for the user input screens section is: (1) a brief description of the screen, (2) a replication of the screen as seen in the spreadsheet, and (3) an explanation of each cell within the screen.

Screen 1

The opening screen of RPGrow$ is also the first user input screen (fig. 2). You should input appropriate values for the growth and yield assumptions and the thinning strategy. RPGrow$ requires at least one thinning before harvesting. Advance to the next screen by following the "Goto" command at the bottom right-hand corner of this screen.

	A	B	C	D	E	F	G
1	RPGrow$ Growth & Yield Assumptions						
2	=========	=========	=========	=========	=========	=========	=========
3	Site Index		60		Bio. Rotation		65
4	Trees/Acre Today		800		Analysis Length		67
5	Stand Age (=>10)		25		Cubic Ft./Cord		79
6	Basal Area/Acre				Cubic Ft./+Cord		79
7	Don't Know = "N"		N		Volume Equation		Lake St.
8	Trees/Acre Initial		890		Log Scale		Intl 1/4
9							
10	Thinning Strategy						
11		Thin	Res.	MAI			
12	Age	Percent	BA	Cords	WARNING		
13	=========	=========	=========	=========	=========	=========	=========
14	25	34.0%	89	0.7	THERE ARE < 200 TREES/ACRE		
15	35	34.0%	98	1.1			
16	45	34.0%	101	1.4			
17	55	34.0%	98	1.5			
18	65	100.0%	0	1.6			
19							
20					Goto Cell A21		

Figure 2.—*RPGrow$ growth and yield assumptions and thinning strategy.*

RPGrow$ Growth and Yield Assumptions

C3 = Site Index	Enter red pine site index in feet, base age = 50. Available site index range is 40 - 80 feet.
C4 = Trees/Acre Today	Enter surviving trees/acre at current stand age. Available range is 50 - 1000 trees/acre.
C5 = Stand Age (=>10)	Stand age is entered later in cell A14. Cell C5 is protected.
C7 = Basal Area/Acre	Enter current basal area in ft^2/acre. Available basal area range is 60 - 180 ft^2/acre. If the basal area in ft^2/acre is unknown AND the current stand is between 10 and 30 years old, RPGrow$ will calculate the basal area (ENTER N).
C8 = Trees/Acre Initial	Enter initial number of trees/acre. Available range is 50 - 1000 trees/acre. The value entered in this cell should <u>not</u> be greater than the value in cell C4, trees/acre today.

G3 = Bio. Rotation	The biological rotation is calculated from subsequent information. This cell is protected.
G4 = Analysis Length	For existing stands, the analysis length is the biological rotation minus the financial base year. For total rotation analysis, the analysis length is calculated from the biological rotation plus the year the stand is established (see cell J31). This cell is protected.
G5 = Cubic Ft./Cord	For RPGrow$, it is assumed that one standard cord contains 79 cubic feet of solid wood. This cell is protected.
G6 = Cubic Ft./+Cord	For RPGrow$, it is assumed that one + cord (the amount of cordwood in trees less than 9 inches d.b.h. in sawtimber stands) contains 79 cubic feet of solid wood. This cell is protected.
G7 = Volume Equation	RPGrow$ uses Buckman's regional volume equation for the Lake States, which is indicated in this cell as "Lake St." This cell is protected. Users in Michigan may wish to change the volume equation to one developed by Fowler and Hussain (1987). See Appendix for more information.
G8 = Log Scale	RPGrow$ uses International 1/4-inch rule log scale as a default, which is indicated in this cell as "Intl 1/4." This cell is protected. Users can change to the Scribner log scale. See Appendix for more information.

Thinning Strategy

A14..A18 = Age	Enter the ages when thinning activity will occur. The first cell (A14) must be greater than or equal to 10 and not greater than 160. Remember, if basal area is being estimated (cell C7 contains the letter N), the beginning age must be between 10 and 30. The spreadsheet "ends" the biological rotation the first time the thinning level is 100%. The maximum number of years between thinnings is 25 years, and the total analysis must not exceed 70 years. See Appendix for additional information on adjusting the number of years between thinnings.
B14..B18 = Thin Percent	Enter the desired thinning level as a percent (0.03 for 3.0%). This is the percentage of the basal area that will be removed at the desired age. Remember to manually recalculate the spreadsheet (F9) after changing the thinning percentages. If you want a specific residual basal area, adjust the thinning percent by trial and error until that residual basal area is contained in cells C14..C18 of this screen.
C14..C18 = Res BA	This is the residual basal area after a thin. These cells are protected.
D14..D18 = MAI Cords	This is the mean annual increment for each age projected. In this example, it is based on Buckman's Lake States volume equation.
E14..E18 = WARNING	Warnings, errors, and notes are displayed in these cells. They are explained in the section "ERROR MESSAGES AND WARNINGS." This cell is protected.

Screen 2

The second user input screen of RPGrow$ contains alternative assumptions and miscellaneous growth and yield calculations (fig. 3). If you want to conduct a marginal analysis of converting an existing forest type to a red pine plantation, enter appropriate values under the alternative assumptions. The miscellaneous growth and yield calculations determine basal area if "N" was entered in cell C7. Advance to the next screen by following the "Goto" command located at the bottom right-hand corner of the screen.

	A	B	C	D	E	F	G	H
21	**Alternative (ALT) Assumptions**							
22	==========	==========	==========	==========	==========	==========	==========	
23	ALT MAI			**0.00**			Cost	Year
24	Cords/Rotation			0			----------	----------
25	Rotation Length			**0**		Activity	**$0.00**	0
26	Value/Cord Today			**$0.00**		Activity	**$0.00**	0
27	Real Price Change							
28	(Above Inflation)			**0.00%**				
29								
30								
31								
32	**Miscellaneous Growth & Yield Calculations**							
33	==========	==========	==========	==========	==========	==========	==========	
34	BA Today		135	135	Calculated initial BA			
35	Age at DBH		17	8	Calculated years to reach DBH			
36	Input Years to DBH		**0**					
37								
38								
39					**Goto Cell I1**			

Figure 3.—*Alternative assumptions.*

Alternative (ALT) Assumptions

D23 = ALT MAI	Enter the Mean Annual Increment (cords of an alternative stand) for a marginal analysis. Zero can be entered to eliminate all revenue from the alternative. If there is no revenue from the alternative, then the costs should also be zero.
D24 = Cords/Rotation	Cords/Rotation is calculated from the MAI and the rotation length. This is a protected cell.
D25 = Rotation Length	Enter the rotation length for the alternative stand.
D26 = Value/Cord Today	Enter the current stumpage value per cord for the alternative stand.
D27 = Real Price Change (Above inflation)	Enter any anticipated real price change over the length of the analysis as a percent (0.015 for 1.5%).
G25..G26 = Activity Cost	Enter the cost of an investment activity for the alternative stand. Examples include timber stand improvement cuts and thinnings.
H25..H26 = Activity Year	Enter the year the activity takes place in the analysis length (2 for the second year of the analysis).

Miscellaneous Growth and Yield Calculations

Cells C34..D35 calculate basal area if a "N" was entered in cell C7.

C36 = Input Years to DBH	The growth model (Lundgren 1981, Wambach 1967) is for stands between 10 and 24 years old and includes age at d.b.h. as a variable. The years to reach d.b.h. is calculated as a function of site index(SI). It is 9 years for SI = 40, 8 years for SI = 50 or 60, and 7 years for SI = 70. The user has the option to change these values. Cell C36 is available for entering the years to d.b.h. If desired, a formula may be entered to change the age for different site indices. Enter "0" to change the spreadsheet back to its original setting.

Screen 3

The third user input screen of RPGrow$ contains more assumptions (fig. 4). Input appropriate values for the financial and annual incremental cost assumptions. Annual incremental costs are those costs that occur only because of the red pine plantation. Advance to the next screen by following the "Goto" command located at the bottom right-hand corner of the screen.

The distinction between capital costs and other expenses is important because they are treated differently for income tax purposes. Any costs that landowners incur to establish or acquire their timber stands can be "capitalized." These costs can be recovered through depletion or amortization. Examples include the cost of purchased seed, planting stock, and paid labor (Potter-Witter 1988). Other expenses can be deducted in full or "expensed" the year they are paid or incurred. Examples include the cost of herbicides used for release and harvesting costs. Existing capitalized expenses must be entered in cell L8.

	I	J	K	L	M	N	O	P
1	**RPGrow$ Financial Assumptions**							
2	========	========	==========	=========	=========	=========	=========	=========
3	Financial Base Year			0		Yield Tax		10%
4	Discount Rate			7.00%		Income Tax		34%
5	Inflation Rate			3.00%		Cap Gains Tax		34%
6	"Inflation Free"			3.88%		Value/Cord Today		$7.25
7	Existing Capitalized					Real Price Change		0.50%
8	Expenses			$0.00		Value/MBF Today		$81.50
9						Real Price Change		1.50%
10								
11	**Annual Red Pine Incremental Cost Assumptions**							
12						After Tax (AT)		
13	Incremental		Annual	Years	Present	Annual	Present	
14	Cost		Costs	0 - ?	Value	Costs	Value	
15	========	========	==========	=========	=========	=========	=========	
16	MGT (expensed)		$1.00	6	$6.26	$0.66	$4.13	
17	OTHER (expensed)		$0.00	0	$0.00	$0.00	$0.00	
18	--------	--------	----------	----------	----------	----------	----------	
19	SUM				$6.26		$4.13	
20							Goto Cell I21	

Figure 4.—*Financial assumptions and annual red pine incremental cost assumptions.*

RPGrow$ Financial Assumptions

L3 = Financial Base Year	Enter the plantation age to which you want to have all the cost and revenues discounted. If site preparation costs occur before the stand is established, the financial base year should be "0." All costs and revenues will be discounted to the financial base year even if the stand is established in a later year (cell J31). For existing stands, enter the current age. No costs or revenues are allowed before the financial base year. However, existing capitalized expenses may be entered in cell L8.
L4 = Discount Rate	Enter the relevant discount rate (0.03 for 3.00%) to be used in the analysis. If you desire the real rate, be sure to enter 0.00% for the inflation rate.

L5 = Inflation Rate	Enter the inflation rate (0.03 for 3.00%).
L6 = "Inflation Free"	This is the real discount rate calculated from the discount rate and the inflation rate ((1 +L4)/(1 +L5))-1. This cell is protected.
L8 = Existing Capitalized Expenses	Enter any existing capitalized expenses. Existing stands will often have capitalized costs associated with them. For income tax purposes, these expenses will be depleted during revenue generation harvests.
P3 = Yield Tax	Enter any applicable yield tax. The yield tax must be entered as a percent and is applied to gross revenue. It is considered expensed for tax purposes (0.03 for 3.00%).
P4 = Income Tax	Enter the income tax rate as a percent (0.03 for 3.00%).
P5 = Cap Gains Tax	Enter the capital gains tax rate as a percent (0.03 for 3.00%). Even if the capital gains tax equals the income tax, it must still be entered.
P6 = Value/Cord Today	Enter the current stumpage value per standard cords.
P7 = Real Price Change (Above Inflation)	Enter any anticipated real pulpwood price change over the length of the analysis as a percent (0.015 for 1.5%).
P8 = Value/MBF Today	Enter the current stumpage value per MBF International 1/4-inch rule log scale. If pulpwood is the only product, enter 0.00 for the Value/MBF Today in cell P8.
P9 = Real Price Change (Above Inflation)	Enter any anticipated real sawtimber price change over the length of the analysis as a percent (0.015 for 1.5%).

Annual Red Pine Incremental Cost Assumptions

K16 = MGT(expensed)	Enter any incremental annual management cost that occurs only because of the red pine plantation (for example, overhead management costs). This cost must occur in the financial base year (L3) and continue every year including the year contained in cell L16. This annual cost is expensed for income tax purposes.
L16 = Years	Enter the last year for the incremental management cost. The first year is the financial base year (L3). The example in figure 4 would have seven payments of $1.00 beginning in year 0 (the financial base year) and ending with year 6.
K17 = Other (expensed)	Enter any other incremental annual cost that occurs only because of the red pine plantation. Examples include fire break maintenance, Integrated Pest Management scouting, or Commercial Forest Act taxes. This cost must occur in the financial base year (L3) and continue every year including the year contained in cell L17. This annual cost is expensed for income tax purposes.
L17 = Years	Enter the last year for the other annual increment cost. The first year is the financial base year (L3).

M16..M17 = Present Value of Annual Costs	This is the present value (PV) of the annual red pine incremental cost. This cell is protected.
N16..N17 = After Tax (AT) Annual Costs	These cells are annual costs including tax effects. These cells are protected.
O16..O17 = At Present Value of Annual Costs	This is the present value (PV) of the annual red pine incremental cost after taxes. These cells are protected.

Screen 4

The fourth user input screen of RPGrow$ is the first of two screens of one-time incremental cost assumptions (fig. 5). Input appropriate values for the one-time costs associated with red pine plantation establishment and culture. The most important cell to enter is J31, the year the stand is planted (Plnt/Acre). This year is used when a full rotation is being simulated to calculate the analysis length. Advance to the next screen by following the "Goto" command located at the bottom right-hand corner of the screen.

	I	J	K	L	M	N	O	P
21	One-Time Incremental Cost Assumptions (Screen 1 of 2)							
22							AT	AT
23				Todays	Actual	Present	Actual	Present
24		Year	Unit	Cost/Unit	Cost	Value	Cost	Value
25	========	========	==========	==========	==========	==========	==========	==========
26	SitePrep	0	1	**15.00**	15.00	15.00	15.00	15.00
27	SitePrep	1	1	**50.00**	51.50	48.13	51.50	48.13
28	SitePrep	1	1	**0.00**	0.00	0.00	0.00	0.00
29	SitePrep	1	1	**0.00**	0.00	0.00	0.00	0.00
30	SitePrep	1	1	**0.00**	0.00	0.00	0.00	0.00
31	PlntAcre	2	1	**50.00**	53.05	46.33	53.05	46.33
32	Stock	2	890	**0.09**	84.98	74.22	84.98	74.22
33	Release	4	1	**50.00**	56.28	42.93	37.14	28.34
34	Release	4	1	**0.00**	0.00	0.00	0.00	0.00
35	Harvest	27	1	**1.00**	2.22	0.36	1.47	0.24
36	Harvest	37	1	**2.00**	5.97	0.49	3.94	0.32
37	Harvest	47	1	**2.00**	8.02	0.33	5.30	0.22
38	Harvest	57	1	**2.00**	10.78	0.23	7.12	0.15
39	Harvest	67	1	**2.00**	14.49	0.16	9.56	0.10
40							Goto Cell I41	

Figure 5.—*One-time incremental cost assumptions - screen 1.*

One-Time Incremental Cost Assumptions

J26..J30 = SitePrep	Enter the year when the site preparation cost occurs. Any costs that appear before the financial base year (cell L3) will be ignored. Site preparation costs are capitalized for income tax purposes.
K26..K30 = SitePrep	Enter the number of units for this activity. Units may be any desirable measure (acres, machine hours, labor hours, etc.).
L26..L30 = SitePrep	Enter the current cost per unit for the site preparation activity.
J31 = Plnt/Acre	Enter the year the stand is planted.
K31 = Plnt/Acre	Enter the number of units for this activity. Planting costs are capitalized for income tax purposes.
L31 = Plnt/Acre	Enter the current cost to plant the site.
J32 = Stock	The value for this cell comes from cell J31, the year the stand is planted. This cell is protected.
K32 = Stock	The number of seedlings comes from the initial number of trees/acre (cell C8). This cell is protected.
L32 = Stock	If desired, enter the current cost per seedling. Seedling costs are capitalized for income tax purposes.
J33..J34 = Release	If desired, enter the year of release. Release costs are expensed for income tax purposes.
K33..K34 = Release	If desired, enter the number of units for this activity.
L33..L34 = Release	If desired, enter the current cost/acre for plantation release.
J35..J39 = Harvest	The year of the harvest cost is automatically calculated using the ages in the thinning strategy.
K35..K39 = Harvest	If desired, enter the number of units for this activity.
L35..L39 = Harvest	If desired, enter the harvest cost per unit. Harvest and costs are expensed for income tax purposes.

Screen 5

The fifth and last user input screen is the second of two screens of one-time incremental cost assumptions (fig. 6). Input appropriate values for any miscellaneous one-time costs associated with the establishment and culture of your red pine plantation.

After all values are entered, go back through the five user input screens again to make sure you've entered the correct values. Then recalculate (F9 key) the spreadsheet before interpreting the results of the analysis.

	I	J	K	L	M	N	O	P
41	One-Time Incremental Cost Assumptions (Screen 2 of 2)							
42								
43							AT	AT
44				Todays	Actual	Present	Actual	Present
45		Year	Unit	Cost/Unit	Cost	Value	Cost	Value
46	========	========	==========	=========	=========	=========	=========	=========
47	MiscCost	0	1	0.00	0.00	0.00	0.00	0.00
48	MiscCost	0	1	0.00	0.00	0.00	0.00	0.00
49	MiscCost	0	1	0.00	0.00	0.00	0.00	0.00
50	MiscCost	0	1	0.00	0.00	0.00	0.00	0.00
51	MiscCost	0	1	0.00	0.00	0.00	0.00	0.00
52	YieldTax	27	-		11.09	1.78	7.32	1.18
53	YieldTax	37	-		38.65	3.16	25.51	2.09
54	YieldTax	47	-		156.66	6.52	103.40	4.30
55	YieldTax	57	-		518.54	10.96	342.23	7.24
56	YieldTax	67	-		3561.53	38.28	2350.61	25.26
57	----------	----------	----------	----------	----------	----------	----------	----------
58	SUM					288.88	3098.11	253.11

Figure 6.—*One-time incremental cost assumptions - screen 2.*

One-Time Incremental Cost Assumptions

J47..J51 = MiscCost	Enter the year of any miscellaneous costs. Miscellaneous costs are expensed for income tax purposes.
K47..K51 = MiscCost	Enter the units of any miscellaneous costs.
L47..L51 = MiscCost	Enter the miscellaneous cost per unit.
J52..P56 = YieldTax	The yield tax is automatically calculated using the yield tax percentage entered in cell P3. These cells are protected.

The present value of the one-time incremental cost is calculated in cells N26..N39 and N47..N56. The actual cost, including tax effects, is calculated in cells O26..O39 and O47..O56. The present value of the one-time incremental cost, including tax effects, is calculated in cells P26..P39 and P47..P56.

OTHER SCREENS

Growth and Yield Summary

Growth and yield summary information can be viewed in cells A41..H133 (fig. 7). The output includes age, height, number of trees, mean d.b.h., basal area, units, cords, MBF (International 1/4-inch scale), + cords (the amount of cordwood in trees less than 9 inches d.b.h. in sawtimber stands). This information is provided for each age that a thinning takes place.

Age	25						
Height	31						
		Mean					
	# Trees	DBH	BA	Cunits	Cords	MBF	+Cords
	---	---	---	---	---	---	---
Before	800	5.6	135	17.2	17.7	0.0	0.0
Removals	272	5.6	46	5.8	6.0	0.0	0.0
After	528	5.6	89	11.3	11.7	0.0	0.0
		Cum. Vol		17	18	0	0
		MAI		0.7	0.7	0.0	0.0
Age	35						
Height	44						
		Mean					
	# Trees	DBH	BA	Cunits	Cords	MBF	+Cords
	---	---	---	---	---	---	---
Before	528	7.2	149	26.6	33.7	1.0	27.9
Removals	180	7.2	51	9.1	11.5	0.3	9.5
After	348	7.2	98	17.6	22.3	0.6	18.4
		Cum. Vol		32	40	1	28
		MAI		0.9	1.1	0.0	0.8
Age	45						
Height	55						
		Mean					
	# Trees	DBH	BA	Cunits	Cords	MBF	+Cords
	---	---	---	---	---	---	---
Before	348	9.0	152	34.2	43.3	5.8	21.9
Removals	118	9.0	52	11.6	14.7	2.0	7.5
After	230	9.0	101	22.6	28.6	3.8	14.5
		Cum. Vol		49	61	6	31
		MAI		1.1	1.4	0.1	0.7

Figure 7.—*Growth and yield summary.*

(Figure 7 continued on next page)

(Figure 7 continued)

Age	55						
Height	65						
		Mean					
	# Trees	DBH	BA	Cunits	Cords	MBF	+Cords
	---	---	---	---	---	---	---
Before	230	10.9	149	39.3	49.8	14.4	9.0
Removals	78	10.9	51	13.4	16.9	4.9	3.0
After	152	10.9	98	26.0	32.9	9.5	5.9
		Cum. Vol		66	82	17	26
		MAI		1.2	1.5	0.3	0.5
Age	65						
Height	73						
		Mean					
	# Trees	DBH	BA	Cunits	Cords	MBF	+Cords
	---	---	---	---	---	---	---
Before	152	13.1	142	42.1	53.4	22.2	0.0
Removals	152	13.1	142	42.1	53.4	22.2	0.0
After	0	0	0	0.0	0.0	0.0	0.0
		Cum. Vol		82	102	29	20
		MAI		1.3	1.6	0.5	0.3

Red Pine Revenue

Harvest volumes and revenues for the analysis can be viewed in cells I61..P77 (fig. 8). The entire screen is calculated. Output includes year of harvest, volume, actual revenue per unit, actual revenue and present value of revenue, and after tax (AT) revenue and present value of revenue. The abbreviation for cords is "Cds."

	I	J	K	L	M	N	O	P
61	Red Pine Revenue							
62				Actual			AT	AT
63				Revenue/	Actual	Present	Total	Present
64		Year	Unit	Unit	Revenue	Value	Revenue	Value
65	========	========	=========	=========	=========	=========	=========	=========
66	Thin(Cds)	27	6.02	18.43	110.85	17.84	96.81	15.58
67	Thin(MBF)	27	0.00	270.61	0.00	0.00	0.00	0.00
68	Cut(Cds)	37	9.48	26.03	246.67	20.18	175.70	14.37
69	Cut(MBF)	37	0.33	422.06	139.84	11.44	95.00	7.77
70	Cut(Cds)	47	7.46	36.77	274.26	11.41	186.23	7.74
71	Cut(MBF)	47	1.96	658.28	1292.34	53.74	858.02	35.68
72	Cut(Cds)	57	3.04	51.94	158.10	3.34	105.57	2.23
73	Cut(MBF)	57	4.90	1026.70	5027.27	106.28	3323.57	70.26
74	Cut(Cds)	67	0.00	73.38	0.00	0.00	0.00	0.00
75	Cut(MBF)	67	22.24	1601.31	35615.28	382.76	23519.28	252.76
76	----------	----------	----------	----------	----------	----------	----------	----------
77	SUM					606.99	28360.18	406.41

Figure 8.—*Red pine revenue.*

Timber Account

For tax purposes, timber is considered a capital investment. The distinction between capital costs and other expenses is important because they are treated differently for income tax purposes. The rationale behind this distinction is to tax timber growers only on their profits, i.e. sale value - capital investment. One method of recovering capital costs is through a depletion allowance taken when timber is sold. The depletion allowance is the amount the IRS will allow deducted from taxable income when timber is sold. It is calculated from the timber basis and the amount of timber sold (Potter-Witter 1988).

The timber basis is the value of planting stock and other costs of stand establishment, or the value of standing timber when purchased, inherited, or otherwise acquired (Potter-Witter 1989).

The timber account is located in cells I101..P110 of the spreadsheet (fig. 9). In RPGrow$ the timber basis is located in cell J103. Harvest years are in cells I104-I108, and their respective depletion allowances are in cells K104-K108. For example, the depletion allowance for the thinning done in year 25 is $69.54. By the end of the rotation the timber basis should equal $0.00.

	I	J	K	L	M	N	O	P
101	Timber Account							
102	========	========	==========					
103	INITIAL	$204.52						
104	25	$134.99	$69.54					
105	35	$89.09	$45.89					
106	45	$58.80	$30.29					
107	55	$38.81	$19.99					
108	65	$0.00	$38.81					
109			----------		NOTE: Depletion is based on cunits			
110			$204.52					
111								

Figure 9.—*Timber account.*

RESULT SCREENS

Yearly Growth Summary

The yearly growth summary can be viewed in cells A141..G210. Output includes age, d.b.h., mean height, basal area (BA), cords and mean annual increment (MAI) over the total rotation, and current annual increment (CAI). An example of a portion of the yearly growth summary for the given input data is shown (fig. 10).

For graphical representation of the growth summary, perform the following Lotus 1-2-3 commands: **G**raph, **T**ype, **X**y, **X**, enter data range D146..D210, **A**, enter data range F147..F210, **B**, enter data range G148..G210, **O**ptions, **T**itles, **F**irst, enter "Yearly Growth Summary," **T**itles, **X**-Axis, enter "Years," **T**itles, **Y**-Axis, enter "Cords/ acre," **L**egends, **A**, enter "MAI," **L**egends, **B**, enter "CAI," **Q**uit, **V**iew.

Yearly Growth Summary						
				Total Rotation		
		Mean		---	---	
Age	DBH	Height	BA	Cords	MAI	CAI
=========	=========	=========	=========	=========	=========	=========
24						
25	5.6	31	89	14	0.8	
26	5.7	32	95	16	0.8	1.6
27	5.9	33	101	17	0.9	1.7
28	6.1	35	107	19	0.9	1.8
29	6.3	36	114	21	0.9	1.8
30	6.4	37	120	23	1.0	1.9
31	6.6	38	126	25	1.0	2.0
32	6.8	40	132	27	1.0	2.0
33	6.9	41	137	29	1.1	2.1
34	7.1	42	143	31	1.1	2.1
35	7.2	43	149	33	1.1	2.2
36	7.4	44	104	24	1.1	#N/A
37	7.6	46	110	26	1.2	1.9
38	7.8	47	115	28	1.2	2.0
39	8.0	48	121	30	1.2	2.0
40	8.2	49	126	32	1.2	2.1
41	8.3	50	132	34	1.3	2.1
42	8.5	51	137	36	1.3	2.2
43	8.7	52	142	38	1.3	2.2
44	8.8	53	147	41	1.3	2.2
45	9.0	54	152	43	1.3	2.2

Figure 10.—*Yearly growth summary.*

Financial Summary

The financial analysis is based on discounted cash flow (fig. 11). All costs and revenues are discounted to the start of the analysis to determine their effect on present value. The cash flows are determined from management activities you specify. All cells are calculated and protected. (For a summary of the theory and practice of forestry investment analysis, see Rose *et al.* 1988.)

WARNING—It is extremely important to recalculate the spreadsheet before accepting any analysis (the "CALC" cell appears in the lower right of the screen if the spreadsheet needs recalculating). Also, make sure the correct variables are entered into all unprotected cells before interpreting the results.

	I	J	K	L	M	N	O	P
81								
82	Financial Summary							
83								
84								
85	No Income Tax				Includes Income Tax Effects			
86	========	========	==========		=========	=========	=========	
87	PV Costs		$295.14		PV Costs		$257.25	
88	PV Revenue		$606.99		PV Revenue		$406.41	
89	Total PNV		$311.85		Total PNV		$149.16	
90								
91	PV Costs (ALT)		$0.00		PV Costs (ALT)		$0.00	
92	PV Revenue (ALT)		$0.00		PV Revenue (ALT)		$0.00	
93	Total PNV (ALT)		$0.00		Total PNV (ALT)		$0.00	
94	Marginal				Marginal			
95	PNW		$311.85		PNW		$149.16	
96								

Figure 11.—*Financial summary.*

Financial Summary

K87 = PV Costs	The present value (PV) of the costs associated with the red pine stand. This is the summation of all the discounted costs.
K88 = PV Revenue	The present value (PV) of the revenue associated with the red pine stand. This is the summation of all the discounted revenue.
K89 = Total PNV	The total present net value (PNV) of the red pine stand is the PV revenue minus the PV costs (K88-K87).
K91 = PV Costs (ALT)	The present value (PV) of the costs associated with the alternative stand in the marginal analysis. This is the summation of all the discounted costs.
K92 = PV Revenue (ALT)	The present net value (PNV) of the revenue associated with the alternative stand in the marginal analysis. This is the summation of all the discounted revenue.
K93 = Total PNV (ALT)	The total present net value (PNV) of the alternative stand in the marginal analysis is the PV revenue minus the PV costs (K92-K91).
K95 = Marginal PNW	The marginal present net worth (PNW) is the total red pine PNV minus the total alternative PNV.

Cells O87..O95 contain the income tax effects on the analysis.

After entering the cost and revenue variables, you can change the thinning strategy and analyze the financial changes.

PRINTING AND SAVING SPREADSHEETS

Printing

Remember to use the F9 key to recalculate the spreadsheet if the CALC message appears at the bottom of the screen (before interpreting any results or printing). Any part of RPGrow$ can be printed by following Lotus print commands and using the print ranges given below.

Assumptions	**Print Range**
Growth & Yield	A1..G8
Thinning Strategy	A10..G18
Alternative	A21..H28
Financial	I1..P9
Annual Incremental Costs	I11.O19
One-Time Incremental Costs	
Screen 1 of 2	I21..P39
Screen 2 of 2	I41..P58
Calculations	**Print Range**
Misc. Growth & Yield	A32..H36
Revenue	I61..P77
Timber Account	I101..P110
Initial Growth	Q1..AB77
2nd Growth	R79..AB154
3rd Growth	R156..AB231
4th Growth	R233..AB308
Summary	**Print Range**
Growth & Yield	A41..H133
Yearly Growth	A141..G210
Financial	I82..O95

Saving Spreadsheets

You may wish to save template versions of the spreadsheet for different site indices or investment levels. Different versions will need to be saved with different file names. For example, a template for site index 75 would be saved as C:\123\RPine\RP75.WK1. If this template was used for two different investment levels, then these files could be saved as C:\123\RPine\RP75A.WK1 and C:\123\RPine\RP75B.WK1.

ERROR MESSAGES AND WARNINGS

Cells E14..G18 will provide error messages and warnings when input variables are outside of acceptable ranges. Even though multiple errors are possible, only one error message will be displayed at a time. Messages are:

Message	Further Clarification
1. Thinning age is out of sequence.	The harvest schedule (A14..A18) must be in chronological order.
2. The maximum years between thinnings is 25.	The maximum years between the first and last thinning is 70.
3. Thinnings must occur after the financial base year.	
4. The BA is only calculated if C5 <= 30.	
5. Thinning % is greater than 100%.	The maximum thinning percent is 100%.
6. C5 is < 10.	The earliest biological age the simulation may be started at is 10.
7. Thinning > 50%.	Thinning greater than 50% of the stand may result in significant windthrow that will not be accounted for in the model.
8. There are < 200 trees/acre.	This warning indicates that the stand has fewer than 200 trees per acre at some point in the rotation. This is only a potential problem if it occurs early in the rotation.
9. The site index is > 80.	The model was developed from stands with site indices between 45 and 65. REDPINE (Lundgren 1981) limits site indices to 40 - 80.

MODELS

The models used in RPGrow$ are provided for the user's reference.

Volume Models

Total cubic foot volume per acre (C) is estimated from Buckman (1962):

$$C = 0.4085 * B * H$$

where B = basal area, in square feet per acre
H = average height of dominant/codominant trees (ft)

Average height of dominant/codominant trees (ft) from Lundgren and Dolid (1970):

$$H = 1.890 * S * (1 - e ^ -0.01979 * A) ^ 1.3892$$

where S = site index, base 50
A = age in years

The number of standard cords per acre for stands under sawtimber size is estimated using a method developed by Lundgren in REDPINE. The proportion of the stand more than 4 inches d.b.h. (PCRD) and to a variable top diameter of no less than 3.0 inches is calculated as:

$$PCRD = (MDBH + 2 *SD - 4) / (4 * SD)$$

where SD = standard deviation of diameter distribution
MDBH = quadratic mean stand diameter at d.b.h.
SD = 0.37628 * MDBH * e ^ (-0.093346 * MDBH)
MDBH = Square Root of ((B / T) / 0.005454154)

where T = trees per acre

The volume in standard cords (R) is:

$$R = C * PCRD / 79$$

This equation assumes that one standard cord contains 79 cubic feet of solid wood. MBF per acre, using the International 1/4-inch rule, is estimated by the ratio of International board feet to cubic feet for a tree with mean stand d.b.h. and average height (Lundgren 1981). The ratio of board feet to cubic feet is:

$$RATIO = -8.76 + (1.985 * D) - (0.07253 * D ^ 2) + (0.0008421 * D ^ 3) + (0.04951 * H) - (0.00892 * D * H) +(0.0003169 * D ^ 2 * H) - (0.000002786 * D ^ 3 * H)$$

where D = d.b.h. of a specific tree
H = height of a specific tree

Board foot volume (in thousands, MBF) is then estimated as

$$MBF/acre = RATIO * (C * 100) * (PBF/ 1000)$$

where PBF is the fraction of the stand more than 9 inches d.b.h. and to a variable top diameter of no less than 8.0 inches. This is estimated using a relationship from REDPINE:

$$PBF = (MDBH + 2 * SD -9) / (4 * SD)$$

In sawtimber stands, additional cordwood volume ("+ cords") comes from trees under 9.0 inches d.b.h. The equation used to estimate the additional volume is:

$$+ cords = (C * 100) * (PCRD - PBF) /79$$

Topwood, the cordwood above the saw logs of a tree, is not accounted for in sawtimber stands.

Cubic foot volume lost through mortality is estimated using a modification of Scott's (1981) formula for gross cubic foot volume per tree (K):

$$K = MNOT * [0.11 - (0.05977 * (MDBH-SD) ^ 2.0498) + (0.04965 * (MDBH - SD) ^ 2.0198) * ((0.65 * H) ^ 0.3468)]$$

where MNOT = number of trees per acre lost through mortality

For RPAL, Ramm (1989) modified Scott's equation by assuming that the average height of the dead trees would be 65 percent of the average height of the dominant and codominant trees in the stand.

Growth Models

For stands 10 to 24 years old at d.b.h., the average annual basal area growth (ABAG) is estimated by:

X6 = [1 - e ^ (-0.040172 * (BHA + 1))] ^ 1.1677
X7 = [1 - e ^ (-0.0018854 * (NOT - MNOT))]
X8 = [1 - e ^ (-0.040172 * BHA)] ^ 1.1677
X9 = [1 - e ^ (-0.0018854 * NOT)]

ABAG = 6.5653 * S * (X6 * X7 - X8 * X9)

where ABAG = annual basal area growth, square feet per acre
BHA = age at d.b.h.
NOT = number of trees / acre
MNOT = number of mortality trees / acre
S = site index, at age 50

This growth model was developed by Lundgren (1981) using Wambach's (1967) data.

For stands more than 25 years old, the average annual basal area growth (ABAG) in square feet per acre is estimated from Buckman (1962):

ABAG = 1.6889 + (0.041066 * B) - (0.00016303 * B ^ 2) - (0.07658 * A) + (0.0002274 * A ^ 2) + (0.06441 * S)

where B = basal area in square feet / acre
A = age in years
S = site index in ft (base age 50)

All basal area increments are constrained by the maximum annual diameter growth (DMAX) defined from Lundgren (1981):

DMAX = 0.007 * S * e ^ (-0.01 * BHA)

If the stand has more than 40 square feet/acre of basal area, mortality is estimated in terms of basal area per acre:

BAM = B * e ^ (-20 * S / B)

It is assumed that the mean d.b.h. of the dead trees will be equal to the stand's quadratic mean d.b.h. minus one standard deviation (Lundgren 1981). Mortality is then estimated in number of trees per acre (MNOT):

MNOT = BAM / ((MDBH -SD) ^ 2 * pi / 576

Economic Models

The real discount rate or "inflation free rate" is calculated from the discount rate and the inflation rate:

RR = [(1 + NR) / (1 + I)] -1

where NR = nominal discount rate
I = inflation rate

The total net present value is:

PNV = PVrevenues - PVcosts

where PVrevenues = the summation of all discounted revenues
PVcosts = the summation of all discounted costs

The basic formula for discounting is:

Vo = Vn / (1 + i) ^ n

where i = appropriate discount rate
n = time period
Vn = cash flows for the n time period

The marginal present net worth (PNW) is:

PNW = PV - PValt

where PV = the total present value of the stand
PValt = the total present value of converting an existing forest type to a red pine plantation

LITERATURE CITED

Buckman, Robert E. 1962. **Growth and yield of red pine in Minnesota**. Tech. Bull. 1272. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Lake States Forest Experiment Station. 50 p.

Fowler, Gary W.; Hussain, Nemah G. 1987. **Individual tree volume equations for red pine in Michigan**. Lansing, MI: State of Michigan, Department of Natural Resources, Forest Management Division; University of Michigan, School of Natural Resources. 23 p.

Gevorkiantz, S.R. 1947. **Converting volumes between International 1/4-inch rule and Scribner rule**. Tech. Note. LS-283. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Lake States Forest Experiment Station. 1 p.

Lundgren, Allen L. 1981. **The effect of initial number of trees per acre and thinning densities on timber yields from red pine plantations in the Lake States**. Res. Pap. NC-193. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 50 p.

Lundgren, Allen L.; Belcher, David M. 1982 (unpublished). **A user's guide for REDPINE - a computer program for simulating growth and yield of red pine stands in the Lake States**. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 12 p.

Lundgren, Allen L.; Dolid, William A. 1970. **Biological growth functions describe published site index curves for Lake States timber species**. Res. Pap. NC-36. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 8 p.

Marty, Robert J. 1981. **Red pine plantation yield projection, TI59 program 101**. East Lansing, MI: Michigan State University, Department of Forestry. n.p.

Potter-Witter, Karen. 1988. **How to recover capital costs when selling timber**. For. Fact Sheet 01. East Lansing, MI: Michigan State University, Cooperative Extension Service. 2 p.

Potter-Witter, Karen. 1989. **Minimizing federal income tax for forest landowners**. North Cent. Region. Publ. 343. East Lansing, MI: Michigan State University, Cooperative Extension Service. 6 p.

Ramm, Carl W. 1989 (unpublished). **RPAL: a growth and yield simulation model for red pine plantations in the Lake States**. East Lansing, MI: Michigan State University, Forestry Department. 18 p.

Ramm, Carl W. 1990. **RPAL: a growth & yield simulation program for red pine plantations in the Lake States**. Northern Journal of Applied Forestry. 7(2): 96-97.

Rose, Dietmar W.; Blinn, Charles R.; Brand, Gary J. 1988. **A guide to forestry investment analysis**. Res. Pap. NC-284. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 23 p.

Scott, Charles T. 1981. **Northeastern forest survey revised cubic foot volume equations**. Res. Note NE-304. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 3 p.

Wambach, Robert F. 1967. **A silvicultural and economic appraisal of initial spacing in red pine**. St. Paul, MN: University of Minnesota. 294 p. Ph.D. dissertation.

WARNING—Make sure you have a back-up copy of the spreadsheet before attempting any modifications.

Adjusting Number of Years Between Thinnings

To reduce the size of RPGrow$.WK1, the calculations for the first and second growth periods are only calculated for 25 years. If you want these calculations for the entire 70-year rotation, follow these steps:

1. Press the Goto key [**F5**], type "Q32," press **E**nter.
2. Use the following command: **C**opy, type "Q32..AB32," press **E**nter, type "Q33..AB77," press **E**nter.
3. Press the Recalculation key [**F9**].
4. Press the Goto key [**F5**], type "R134," press **E**nter.
5. Use the following command: **C**opy, type "R134..AB134," press **E**nter, type "R135..AB154," press **E**nter.
6. Press the Recalculation key [**F9**].
7. Save the spreadsheet under a new file name, if desired.
8. Ignore the WARNING in cells E14..E18 that states "The maximum years between thins is 25."

Changing Volume Equation

Like REDPINE and RPAL, this spreadsheet uses regional volume equations from Buckman (1962). Users in Michigan may wish to change the volume equation to one developed by Fowler and Hussain (1987). Cubic foot volume to a 3.6-inch top is estimated from the individual tree equation:

V = [(0.002974*DBH)^1.7143*(H-ADJ)^1.1287]*T

where V = cubic foot volume to a 3.6-inch top
DBH = diameter at breast height in inches
H = height of dominant site index trees in feet
ADJ = height adjustment constant used to adjust the dominant site index height down to the average stand height
T = number of trees per acre

This equation is dependent on average stand diameter and average stand height. The height of dominant trees is already calculated (site index height), but the average height is not readily available. You need to enter an adjustment constant to reduce the dominant tree height. For example, the average height for a site index 60 site may be 5 feet less than the dominant height. Decide upon and use this ADJ constant in the modification steps below. For this example, anywhere "ADJ" appears in a formula, it would be replaced by "5."

Pulpwood volume in cords is determined by dividing the cubic foot volume by the conversion factor in cell G5. The result is multiplied by 0.96 as recommended by Fowler and Hussain (1987) to compensate for the extra 4 inches of stick length beyond 8 feet.

To change to the Michigan volume equation, three parts of the spreadsheet have to be modified. Follow these steps:

Part 1

1. Use the following commands: **W**orksheet, **G**lobal, **P**rotection, **D**isable.
2. Press the Goto key [**F5**], type "G7," press **E**nter.
3. Press the Edit key [**F2**], delete "Lake St.," type "Mich," press **E**nter.
4. Press the Goto key [**F5**], type "E50," press **E**nter.
5. Press the Edit key [**F2**], edit the formula so the result is: (0.002974*(C50^1.7143)*((B44-ADJ)^1.1287))*B50/100, press **E**nter.
6. Press the Goto key [**F5**], type "E68," press **E**nter.
7. Press the Edit key [**F2**], edit the formula so the result is: (0.002974*(C68^1.7143)*((B62-ADJ)^1.1287))*B68/100, press **E**nter.
8. Use the following command: **C**opy, press **E**nter, type "E88," press **E**nter.
9. Use the following command: **C**opy, press **E**nter, type "E108," press **E**nter.
10. Use the following command: **C**opy, press **E**nter, type "E128," press **E**nter.
11. Press the Recalculation key [**F9**].

Part 2

1. Press the Goto key [**F5**], type "F50", press **E**nter.
2. Press the Edit key [**F2**], edit the formula so the result is:

   ((E50*100)*G44/$G$5)*0.96, press **E**nter.

3. Press the Goto key [**F5**], type "F68," press **E**nter.
4. Press the Edit key [**F2**], edit the formula so the result is:

   ((E68*100)*G62/$G$5)*0.96, press **E**nter.

5. Use the following command: **C**opy, press **E**nter, type "F88," press **E**nter.
6. Use the following command: **C**opy, press **E**nter, type "F108," press **E**nter.
7. Use the following command: **C**opy, press **E**nter, type "F128," press **E**nter.
8. Press the Recalculation key [**F9**].

Part 3

1. Press the Goto key [**F5**], type "AA7," press **E**nter.
2. Press the Edit key [**F2**], edit the formula so the result is:

   ((((0.002974*(T7^1.7143)*((W7-ADJ)^1.1287))*V7)/$G$5)*0.96)-((V6-V7)*(0.11 -(0.0598*((T6-U6)^2.02))+(T6-U6)^2.02)*((0.65*W6)^0.3468)))/$G$5, press **E**nter.

3. Use the following command: **C**opy, press **E**nter, type "AA8..AA77," press **E**nter.
4. Press the Goto key [**F5**], type "AA84," press **E**nter.
5. Press the Edit key [**F2**], edit the formula so the result is:

   @IF(Y84<$A$15,"",(((0.002974*(T84^1.7143)*((W84-ADJ)^1.1287))*V84)/$G$5-((V83-V84)*(0.11-(0.0598*((T84-U84)^2.05))+0.0496*(T84-U84)^2.02)*((0.65*W84)^0.3468)))/$G$5), press **E**nter.

6. Use the following command: **C**opy, press **E**nter, type "AA85..AA154," press **E**nter.
7. Press the Goto key [**F5**], type "AA161," press **E**nter.
8. Press the Edit key [**F2**], edit the formula so the result is:

   @IF(Y161<$A$16,"",(((0.002974*(T161^1.7143)*((W161-ADJ)^1.1287))*V161)/$G$5-((V160-V161)*(0.11-(0.0598*((T161-U161)^2.05))+0.0496*(T161-U161)^2.02)*((0.65*W161)^0.3468)))/$G$5), press **E**nter.

9. Use the following command: **C**opy, press **E**nter, type "AA162..AA231," press **E**nter.
10. Press the Goto key [**F5**], type "AA238," press **E**nter.
11. Press the Edit key [**F2**], edit the formula so the result is:

    @IF(Y238<$A$17,"",(((0.002974*(T238^1.7143)*((W238 ADJ)^1.1287))*V84)/$G$5-((V237-V238)*(0.11-(0.0598*((T238-U238)^2.05))+0.0496*(T238-U238)^2.02)*((0.65*W238)^0.3468)))/$G$5), press **E**nter.

12. Use the following command: **C**opy, press **E**nter, type "AA239..AA308," press **E**nter.
13. Press the Recalculation key [**F9**].
14. Use the following commands: **W**orksheet, **G**lobal, **P**rotection, **E**nable.
15. Save the spreadsheet under a new filename, if desired.

Changing Log Scale

The log scale can be changed between International 1/4-inch and Scribner. Be sure that the price entered in cell P8 is for the correct log scale. Cell G8 indicates the default log scale, International 1/4-inch. The conversion used is based on Gevorkiantz (1947) for logs 10 to 18 inches.

$$S = I * C$$
$$C = 0.619 + (0.0165 * DBH)$$

where S = Scribner scale
I = International 1/4-inch scale
C = Conversion factor
DBH = Diameter at breast height in inches

To modify the spreadsheet, follow these steps:

1. Press the Goto key [**F5**], type "G8," press **E**nter.
2. Press the Edit key [**F2**], delete "Intl 1/4," type "Scribner," press **E**nter.
3. Press the Goto key [**F5**], type "G50," press **E**nter.
4. Press the Edit key [**F2**], edit the formula so the result is:

   ((-8.76+(1.985*C50)-
   (0.7253*C50^2)+(0.0008421*
   C50^3)+(0.04958*B44)-
   (0.00892*C50*B44)+ (0.00031
   69*C50^2*B44)-
   (0.000002786*C50^3*B44))*
   (E50*100)*(G45/
   1000)*(0.619+(0.0165*C50))), press **E**nter.

5. Press the Goto key [**F5**], type "G68," press **E**nter.
6. Press the Edit key [**F2**], edit the formula so the result is:

   ((-8.76+(1.985*C68)-
   (0.7253*C68^2)+(0.0008421*C68^3)+
   (0.04958*B62)-(0.00892*C68*B62)+
   (0.0003169*C68^2*B62)-
   (0.000002786*C68^3*B62))*
   (E68*100)*(G63/1000)*
   (0.619+(0.0165*C68))), press **E**nter.

7. Use the following command: **C**opy, press **E**nter, type "G88," press **E**nter.
8. Use the following command: **C**opy, press **E**nter, type "G108," press **E**nter.
9. Use the following command: **C**opy, press **E**nter, type "G128," press **E**nter.
10. Press the Recalculation key [**F9**].
11. Save the spreadsheet under a new filename, if desired.

To obtain a disk copy of RPGrow$.WK1 for MS-DOS computers, send a floppy disk to the following address:

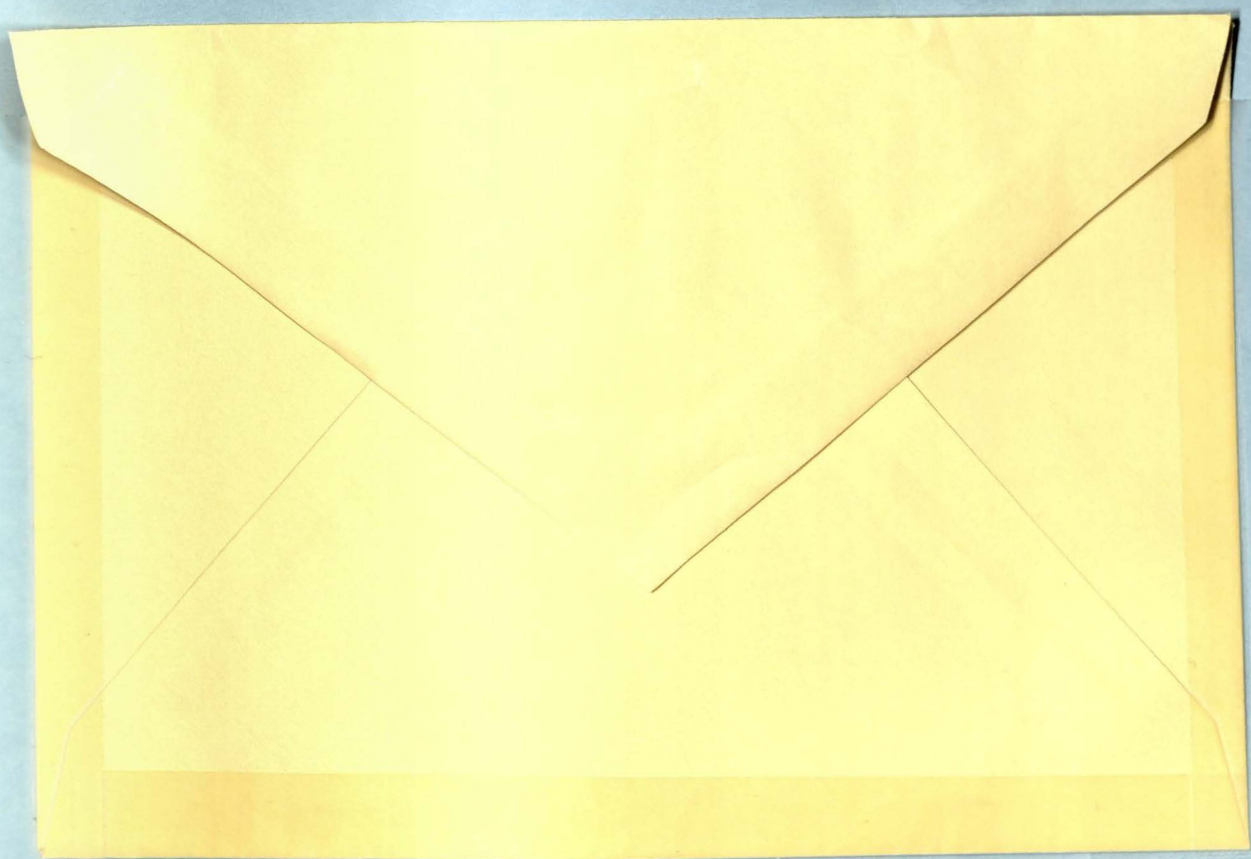
Forest Economics Research Unit
North Central Forest Experiment Station
1407 S. Harrison Road
East Lansing, MI 48823-5200

☆U.S. GOVERNMENT PRINTING OFFICE: 1993 - 758-851/80074

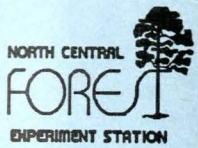
Hyldahl, Carol A.; Grossman, Gerald H.
1993. **User's guide: RPGrow$: a red pine growth and analysis spreadsheet for the Lake States**. Gen. Tech. Rep. NC-156. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 27 p.

Describes PRGrow$, a stand-level, interactive spreadsheet for projecting growth and yield and estimating financial returns of red pine plantations in the Lake States. This spreadsheet is based on published growth models for red pine. Financial analyses are based on discounted cash flow methods.

KEY WORDS: Red pine, growth models, financial analyses, discounted cash flows, spreadsheet.



Our job at the North Central Forest Experiment Station is discovering and creating new knowledge and technology in the field of natural resources and conveying this information to the people who can use it. As a new generation of forests emerges in our region, managers are confronted with two unique challenges: (1) Dealing with the great diversity in composition, quality, and ownership of the forests, and (2) Reconciling the conflicting demands of the people who use them. Helping the forest manager meet these challenges while protecting the environment is what research at North Central is all about.



Printed on recycled and recyclable paper.